The Connecticut Agricultural Experiment Station, New Haven

Broccoli Trials 2000-2002

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SUMMARY

In 2000-2002, a total of 16 cultivars of broccoli were grown at Windsor on a sandy terrace soil and at Mt. Carmel on a loamy upland soil. For spring harvest, a total of four crops were transplanted at both sites in mid-to-late May. For fall harvest, a total of three crops were transplanted in early-to-mid August. In spring crops, average yield of all cultivars within plantings ranged between 9,910-8,515 lb/A at Windsor and 9,240-3,600 lb/A at Mt. Carmel. In fall crops, average yield of all cultivars within plantings ranged between 14,980-9,525 lb/A at Windsor and 9,240-3,360 lb/A at Mt. Carmel. Low average yield in spring 2001 Crop 1 at Mt. Carmel was due to a late infestation of root maggots that stunted many plants. Low average yield in fall crop 2002 at Mt. Carmel was due to a heavy infestation of flea beetles on newly planted transplants that delayed normal growth several weeks.

In spring, yields of Fiesta, Gypsy, Sussex, and Windsor were above average throughout the planting period. The quality of their high-domed heads was excellent. In fall, yields of Captain, Fiesta, Goliath, Gypsy, Major, Signal, Sussex, Titleist, and Windsor were above average with excellent quality when planted by mid-July. Captain and Major had excellent yield and quality when planted in early August.

For ease of harvest and trimming, Captain, Goliath, Gypsy, Signal, and Sussex provided high-domed heads that extended above the leaf canopy. The heads of Belstar, Fiesta, Titleist and Windsor were borne on short, thick stalks that were somewhat recessed within the leaf canopy. These cultivars were more difficult to harvest but their use was ideal for short-stemmed crown cuts or florets.

Days to maturity and harvest span were determined for all cultivars to allow growers to estimate approximate harvest dates for spring and fall crops. Cultivars with short harvest spans can be selected for a single harvest by machine or hand or long harvest spans to maintain daily supplies for roadside stands or farmer's markets.

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INTRODUCTION

About 10 years ago, the American Medical Association and nutritionists began to extol the virtues of broccoli *(Brassica oleraceae)* as an important component of human diet. Broccoli has a high sulforaphane content that has been identified as an anti-cancer agent. Consumers heeded the reports by increasing their annual consumption of broccoli from 0.5 lb in 1970 to 3.1 lb in 1994 (Karst 1994). Most recently, the US Department of Agriculture reported that the annual consumption of broccoli reached 6.7 lb in 2000 (Anon 2000). They also reported that the area devoted to broccoli in the United States increased from 77,850 acres in 1980 to 144,300 acres in 2000, an 84% increase, with California, Arizona, and Texas the main producers.

Production in Connecticut. Traditionally, broccoli has been grown from late June through early October with little planted to mature in the heat of July and August. In 1982, 41 acres were grown in Connecticut (Stephens 1988) mostly for direct marketing through roadside stands. In 1985, the "Broccoli Project" was established by the Connecticut Department of Agriculture. They enlisted several growers to supply broccoli to two supermarket chains who agreed to sell Connecticut-grown produce. By 1988, broccoli acreage increased to more than 100 acres (Hill 1989). The Connecticut Agricultural Experiment Station's role in the project was testing new cultivars (cultivated varieties) to determine those best suited for Connecticut's soil and climate. From 1985 to 1988, 48 cultivars were tested and reported (Hill 1986, 1987, 1988, 1989). New trials were initiated in 1993-1994 to test 19 new cultivars released by seed companies since 1989 (Hill 1995). All trials determined yield and quality for spring and fall production.

Current outlook. The rapid growth of the food service industry, which encompasses fast-food chains, restaurants, school and corporate cafeterias, and hospitals, created an ever-increasing demand for broccoli. In 2000, 59,390 tons of broccoli were purchased by the food service industry for processing (Anon 2000). Although the sales of whole heads of broccoli remain dominant, sales of pre-cut broccoli has greatly increased. Broccoli can now be purchased as loose or packaged florets or crown cuts (stems less than 5 inches long). Their stems have been sliced to form coins and sticks for party snacks and slaw for salads.

Since the completion of the second trials in 1994, seed companies have developed and released 16 new cultivars that alter the shape of the head, ease harvesting and trimming, and promote disease resistance. Many of the cultivars tested earlier are no longer available. Of the 67 cultivars previously tested, only 18 are still offered in 2003 seed catalogues.

In this bulletin, I report yield, quality, and maturity of 16 new cultivars grown at Windsor and Mt. Carmel in spring and fall plantings. I shall also discuss strategies to maximize yield through cultivar selection and appropriate planting dates.

METHODS AND MATERIALS

Soils. All broccoli trials were conducted at the Valley Laboratory, Windsor on Merrimac sandy loam, a sandy terrace spoil with limited moisture holding capacity and at Lockwood Farm, Mt. Carmel (Hamden) on Cheshire fine sandy loam with moderate moisture holding capacity.

Cultivars. Seeds were obtained from several domestic suppliers. A total of 16 cultivars were grown throughout 2000-2002 (Table 1). Most of these cultivars were released since 1995. Gypsy, recently named, was tested as SBC 8411.

Table 1. Broccoli cultivars grown at Windsor and Mt. Carmel in 2000-2002 and total plantings

	Maturity	Total Plantings
Belstar	Main Season	4
Captain	Early	4
Fiesta	Late	4
Goliath	Early	4
Green Jewel	Early	2
Gypsy (SBC 8411)	Main Season	4
Landmark	Main Season	8
Lucky	Main Season	4
Major	Early	4
Patriot	Main Season	2
Regal	Early	8
Signal	Main Season	4
Sussex	Main Season	4
Terra Blanca	Early	4
Titleist	Late	6
Windsor	Main Season	8

Table 2. Soil and crop management of broccoli and pertinent dates.

Activity		Spring Crop	Fall Crop
Soil fertilization (rates based on soil tests)			
10-10-10		1000 lb/A	1000 lb/A
Ammonium nitrate		150 lb/A	150 lb/A
(side dress 1 month after transplanting)			
Lime (to attain pH 6.5)		None	None
Planting dates			
Seeding in greenhouse or	1st crop	April 1-4	June 5-21
outdoor enclosure	2nd crop	April 23	
Transfer to cold frame	1st crop	April 23-28	
	2nd crop	May 15	
Transplant seedlings in field	1st crop	May 14-16	August 10-13
	2nd crop	June 1-4	
Pest control			
Root maggots		Lorsban 4E	Lorsban 4E
Cabbage worms		Asana XL	
Flea beetles		Sevin	
Weed control		Cultivation	Cultivation

Culture. Details of management of soils and crops and pertinent dates are listed in Table 2. Seeds for all spring plantings were sown in a greenhouse maintained at 50-70 F. Four-week-old seedlings were moved to a cold frame for hardening about 10 days before they were transplanted in the field. Seeds for all fall crops were sown outdoors in a cold frame.

The seedlings were grown in Promix BX in standard plastic pots (2 5/8 X 2 ¼ X 2 5/16 inches) held in packs of 36. Water-soluble 20-20-20 fertilizer (1 tbsp/gal) was added to the seedlings one week before transplanting. The seedlings were transplanted in rows 36 inches apart with a spacing of 18 inches within rows (equivalent to 9680 plants/acre). Each planting consisted of five randomized blocks with six plants per cultivar in each replication (30 plants/cultivar/crop). Transplanted seedlings that died within the first week were replaced.

Harvest. Mature heads of broccoli were harvested at 3 or 4-day intervals. Broccoli heads were weighed and quality was judged for uniformity and compactness of the head, excessive stalk thickness and length, and leaves protruding from the head.

Rainfall. Rainfall distribution at Windsor and Mt. Carmel throughout the broccoli growing season (May through October) is shown in Table 3. The inches of rainfall in each column represents the departure from the mean monthly rainfall for Hartford (near Windsor) and Mt. Carmel reported by the National Weather Service. Total rainfall at Windsor during the 2000, 2001, and 2002 growing seasons was 24.3, 19.6, and 25.6 inches, respectively, compared to a 30-year average of 20.8 inches. Total rainfall at Mt. Carmel during the same period was 29.2, 23.0, and 26.3 inches, respectively, compared to a 30-year average of 20.8 inches.

In 2000 at Mt. Carmel, rainfall during the growing season was 7.1 inches above normal. Most of the excess occurred in June and July when 14.7 inches of rain fell, accompanied by lower-than-average temperatures. August and October had deficits of 0.4 and 2.5 inches, respectively.

In 2001 at Windsor, total rainfall during the growing season was 19.6 inches or 0.6 inches above normal. Deficits occurred in July (-1.5 inches) and October (-2.3 inches). Although the total rainfall for the growing season appeared normal, the crop was irrigated in May to maintain growth of newly planted seedlings, and in July to maintain adequate water supply. At Mt. Carmel, total rainfall throughout the growing season was 23.0 inches, or 2.2 inches above normal. Although total rainfall for the growing season appeared normal, deficits occurred in July (-1.4 inches), September (-0.9 inches) and October (-1.4 inches). The crop was irrigated twice in July to maintain optimum growth of the plants during the dry month.

In 2002 at Windsor, total rainfall throughout the growing season was 25.5 inches or 6.5 inches above normal. One irrigation in July was necessary to maintain active growth of the plants. At Mt. Carmel, total rainfall throughout the growing season was 26.3 inches, or 5.5 inches above normal. Although total rainfall was above normal, deficits in July (-1.5 inches) and August (-0.2 inches) required two irrigations to offset meager rainfall.

Table 3. Departure of monthly rainfall (inches) from normal during May-October at Windsor and Mt. Carmel, 2000-2002.

	WINDSOR			MT. CARMEL			
	30-year avg	2001	2002	30-year avg.	2000	2001	2002
May	3.4	0.6	2.7	3.7	0.8	2.6	2.2
June	3.2	2.5	1.8	2.5	4.3	2.5	2.3
July	2.6	-1.5	0.3	3.2	4.7	-1.4	-1.5
August	3.4	1.0	0.0	3.9	-0.4	0.8	-0.2
September	3.4	0.3	0.6	4.2	0.2	-0.9	1.6
October	3.0	-2.3	1.1	3.3	-2.5	-1.4	1.1

Table 4. Yield of broccoli at Windsor and Mt. Carmel, Spring 2000-2002.

	WINDSOR			MT. CARMEL		
CULTIVAR	Heads hvst %	Avg. head* lb	Est. total yield lb/A	Heads hvst %	Avg. head* lb	Est. total yield lb/A
2000						
Green Jewel	--	--	--	90	0.9a	7,940
Landmark	--	--	--	97	1.2a	11,270
Patriot	--	--	--	77	1.3a	9,690
Regal	--	--	--	83	0.9a	7,230
Signal	--	--	--	100	1.0a	9,680
Windsor	--	--	--	83	1.2a	9,640
2001 Crop 1						
Landmark	93	1.4a	12,600	67	1.0a	6,490
Regal	87	0.9b	7,580	63	0.4b	2,440
Signal	100	1.1ab	10,650	63	0.4b	2,440
Terra Blanca	87	1.1ab	9,260	43	0.4b	1,660
Titleist	67	1.3a	8,430	63	0.9a	5,490
Windsor	87	1.3a	10,950	63	0.5b	3,050
2001 Crop 2						
Goliath	97	0.9b	8,450	100	0.6b	5,810
Landmark	13	1.2ab	1,510	10	1.1a	1,060
Regal	100	0.8b	7,740	100	0.6b	5,810
Signal	100	0.8b	7,740	90	0.6b	5,230
Terra Blanca	83	1.4a	11,250	73	0.8ab	5,650
Titleist	23	1.4a	3,120	17	0.7ab	1,150
Windsor	97	1.2ab	11,270	93	1.0a	9,000
2002						
Belstar	53	1.6a	8,210	80	1.0a	7,740
Captain	93	0.6a	5,400	100	0.9a	8,710
Fiesta	67	1.2ab	7,780	87	1.1a	9,260
Gypsy (SBC 8441)	93	1.3ab	11,700	93	1.2a	10,800
Lucky	90	1.3ab	11,320	83	1.2a	9,640
Major	90	0.6b	5,230	97	0.5a	4,690
Sussex	90	1.1ab	9,580	93	1.2a	10,800

* Mean separation within columns for each crop by Tukey's HSD multiple comparison test at p=0.05. Values in columns followed by the same letter did not differ significantly.

Table 5. Yield of broccoli at Windsor and Mt. Carmel, Fall 2000-2002.

	WINDSOR			MT. CARMEL		
CULTIVAR	Heads hvst %	Avg. head* lb	Est. total yield lb/A	Heads hvst %	Avg. head* lb	Est. total yield lb/A
2000						
Green Jewel	--	--	--	93	1.3a	11,700
Landmark	--	--	--	100	1.4a	13,550
Patriot	--	--	--	93	1.5a	13,500
Regal	--	--	--	97	1.3a	12,210
Signal	--	--	--	100	1.0a	9,680
Windsor	--	--	--	100	1.4a	13,550
2001						
Goliath	70	1.3b	8,810	100	0.8a	7,740
Landmark	97	2.2a	20,660	97	1.0a	9,390
Regal	77	1.2b	8,940	97	1.1a	10,330
Signal	83	1.1b	8,840	97	1.1a	10,330
Titleist	97	1.5b	14,080	100	0.8a	7,740
Windsor	37	1.3b	4,660	97	1.1a	10,330
2002						
Belstar	93	1.4a	12,600	7	1.0a	680
Captain	97	1.5a	14,080	77	0.8a	5,960
Fiesta	87	1.5a	12,630	0	0	0
Gypsy (SBC 8441)	97	1.8a	16,900	53	0.6a	3,080
Lucky	97	1.7a	15,960	60	0.9a	5,230
Major	93	1.8a	16,900	87	0.6a	6,740
Sussex	100	1.7a	16,460	27	0.7a	1,830

* Mean separation within columns for each crop by Tukey's HSD multiple comparison test at p=0.05. Values in columns followed by the same letter did not differ significantly.

YIELD AND QUALITY

Spring Crop 2000. The average yield of six cultivars, grown only at Mt. Carmel, was 9,240 lb/A (Table 4). The yield of Landmark was greatest (11,270 lb/A). The yields of Patriot, Signal, and Windsor (9,600 lb/A) were also above average. No cultivars, however, exceeded the 2000 national average of 14,500 lb/A (USDA 2002). Although the average head weight of Patriot was greatest (1.3 lb), its estimated yield was diminished by poor quality. Twenty three percent of the plants formed irregular heads that developed in the heat of July. The exerted, high-domed heads of Regal, Signal, and Windsor were of excellent quality. The exerted heads of Landmark were somewhat lumpy in appearance but could be divided into florets or used for processing.

Spring Crops 2001. In Crop 1 at Windsor, the average yield of six cultivars was 9,910 lb/A compared to 3,590 lb/A at Mt. Carmel, a 74% difference (Table 4). The low average yield at Mt. Carmel was due to failure of many plants in all cultivars to produce heads of marketable quality. Most mature heads were small and could only be utilized by bunching to form a marketable unit. A late infestation of root maggots caused stunting of many plants in this crop. The estimated yield of Landmark was greatest (12,600 lb/A) by virtue of the greatest average weight of heads (1.4 lb). The average yields of Signal and Windsor exceeded 10,600 lb/A. Although the heads of Landmark were heaviest among all cultivars, their quality was only fair. The growth of individual florets was uneven, producing a somewhat lumpy head that could be divided into florets or used for processing. The exerted, high-domed heads of Signal and Windsor were of excellent quality and most could be marketed as single units. The semi-domed heads of Titleist were borne on thick stalks and were suitable for crown cuts (heads with 4-5 inch stalks).

At Mt. Carmel, Landmark had the greatest yield (6,490 lb/A). Their heads were somewhat irregular in shape but their average weight (1.0 lb) was sufficient to market them as single units or divide them into florets.

In Crop 2 at Windsor, average yield of seven cultivars was 8,510 lb/A compared to 5,620 lb/A at Mt. Carmel, a 51% difference (Table 4). Lower average yield at Mt. Carmel was largely due to the lack of marketable heads of Landmark (10%) and Titleist (17%). Most of their heads became very uneven as they reached maturity and were unmarketable. At Windsor, average yield of Windsor and Terra Blanca exceeded 11,000 lb/A. Although the heads of Terra Blanca were above average in weight, their thick stalks developed numerous cracks, called checking, a physiological disorder. Their heads, however, could be used for florets. The quality of high-domed Windsor was excellent and could be marketed as single units. The heads of Regal and Goliath weighed less than other cultivars (0.8 lb), but their quality was excellent and could be marketed in bunches.

At Mt. Carmel, cultivar Windsor had the greatest yield (9,000 lb/A) with heads weighing 1.0 lb each and of excellent quality. Excellent quality was also displayed by Goliath and Regal, but their small size would require bunching to create a marketable unit or they could be sold as crown cuts.

Spring Crop 2002. The average estimated yield of seven new cultivars at Windsor was 8,460 lb/A compared to 8,810 lb/A at Mt. Carmel, a 4% difference (Table 4). At Windsor, the yields of Gypsy (11,700 lb/A) and Lucky (11,320 lb/A) were greatest. Both cultivars had high-domed heads that averaged 1.3 lb. The stems of Lucky were short and heavy with little inter-nodal spacing between leaves, making them more difficult to trim. Some late-maturing heads displayed brown-beading, a physiological disorder that reduces marketability. The heads of Gypsy were well exerted with wider spacing between inter-nodes that eased trimming. Belstar had the heaviest heads (1.6 lb), but 46% of its plants formed irregularly shaped heads with little market value. Early maturing cultivars, Major and Captain, formed early heads that weighed least (0.6 lb). About 10% of each cultivar formed very small premature heads (buttoning). Fiesta and Sussex formed high-domed heads of intermediate weight (1.1 lb) with excellent quality. The heads of Fiesta, however, were not well exerted and were more difficult to trim. The heads of Sussex were well exerted that facilitated harvesting and trimming.

At Mt. Carmel, Gypsy and Sussex had the greatest yields (10,800 lb/A). Both cultivars displayed excellent quality with well-exerted heads that were easy to harvest and trim. Lucky and Fiesta also had above-average yields but their high-domed heads were borne on thick stalks that were more difficult to harvest and trim.

Fall Crop 2000. Average yield of six cultivars at Mt. Carmel was 12,365 lb/A (Table 5). The average yield in fall was 33% greater than the average yield in spring. The spring crop was inundated with 14.7 inches of rain in June and July, which leached nitrogen from the topsoil to levels below crop needs. The yields of Landmark, Patriot, and Windsor exceeded 13,500 lb/A. Average head weight among these cultivars exceeded 1.4 lb and virtually all heads were of marketable quality. The crowns of high-domed Landmark and Windsor were well extended above the leaf canopy and eased harvesting and trimming. The high-domed heads of Patriot, borne on short, thick stalks, were somewhat recessed within the leaf canopy. Their use as crown cuts would be preferred. The average yield of Green Jewel and Regal exceeded 11,200 lb/A. The heads of Green Jewel were almost spherical but somewhat recessed among the upper leaves of the plant. The high-domed heads of Regal were extended for easy harvesting and trimming. Late-harvested heads of Signal had a few small leaves protruding from the head.

Fall Crop 2001. Average yield of six cultivars at Windsor was 9,525 lb/A compared to 9,310 lb/A at Mt. Carmel (Table 5). At Windsor, the greatest yield was Landmark (22,660 lb/A), well above the 2000 national average of 14,500 lb/A. The average weight of their semi-domed heads was 2.2 lb, but the quality was only fair. The heads were somewhat uneven in appearance, but they could be divided and marketed as florets. The average yield of Titleist was 14,080 lb/A with high-domed heads weighing 1.5 lb. Their quality was good for fresh market sales. Windsor had the lowest yield (4,660 lb/A) because 63% of their heads were not of marketable value.

At Mt. Carmel, the average yields of Regal, Signal, and Windsor were greatest (10,330 lb/A). The well-extended heads of Regal and Signal averaged 1.1 lb and were of excellent quality. The 1.1 lb heads of Windsor were somewhat depressed within the foliage, which made them more difficult to harvest and trim.

Fall Crop 2002. The fall crops at Windsor and Mt. Carmel were marked by contrast. At Windsor, the average yield of seven cultivars was 14,980 lb/A compared to 3,360 lb/A at Mt. Carmel (Table 5). The average yield at Windsor exceeded the national average in 2000. The yields of Gypsy, Sussex, and Major exceeded 16,200 lb/A. Belstar had the lowest yield (12,600 lb/A). The high-domed heads of Sussex were well extended above the foliage, making them easy to harvest and trim. The quality of their heads was excellent and ideally suited for fresh-market sales as single units. Some heads of Lucky were somewhat lumpy with occasional pockets of soft rot. The semi-domed heads of Major were of excellent quality but checking was noted on the lower parts of some stalks. These heads could be utilized as crown cuts or florets.

Table 6. Average maturity (days) of broccoli cultivars at Windsor and Mt. Carmel, spring and fall 2000-2002.

		SPRING				FALL		
	Catalog maturity	2000	2001 crop 1	2001 crop 2	2002	2000	2001	2002
Belstar	66	---	---	---	64	---	---	76
Captain	64	---	---	---	45	---	---	70
Fiesta	72	---	---	---	60	---	---	88
Goliath	53	---	46	---	---	---	62	---
Green Jewel	56	45	---	---	---	84	---	---
Gypsy (SBC 8411)	59	---	---	---	50	---	---	88
Landmark	66	50	64	64	---	81	78	---
Lucky	63	---	---	---	60	---	---	91
Major	51	---	---	---	41	---	---	70
Patriot	59	54	---	---	---	78	---	---
Regal	62	43	50	38	---	69	60	---
Signal	60	43	50	38	---	62	58	---
Sussex	70	---	---	---	54	---	---	---
Terra Blanca	56	---	50	50	---	---	---	---
Titleist	74	---	64	64	---		86	---
Windsor	70	47	58	57	---	74	62	88
Avg Planting date		5/14	5/2	6/2	5/13	8/10	8/3	8/10

Table 7. Average harvest span (days) of broccoli at Windsor and Mt. Carmel, spring and fall 2000-2002.

	SPRING				FALL		
	2000	2001 Crop 1	2001 Crop 2	2002	2000	2001	2002
Belstar	---	---	---	6	---	---	12
Captain	---	---	---	6	---	---	10
Fiesta	---	---	---	5	---	---	16
Goliath	---	---	13	---	---	15	---
Green Jewel	2	---	---	---	16	---	---
Gypsy (SBC 8411)	---	---	---	4	---	---	10
Landmark	7	8	6	---	11	7	---
Lucky	---	---	---	8	---	---	10
Major	---	---	---	6	---	---	13
Patriot	5	---	---	---	8	---	---
Regal	2	6	8	---	7	10	---
Signal	2	6	7	---	7	---	---
Sussex	---	---	---	6	---	---	10
Terra Blanca	---	6	9	---	---	---	---
Titleist	---	1	7	---	---	10	---
Windsor	9	4	7	---	9	15	---

The stalks of Belstar and Lucky were thick but the domed heads that they bore could be utilized as crown cuts of excellent quality.

At Mt. Carmel, the entire crop was stunted. Only the early-maturing cultivars, Captain and Major, produced small marketable heads that could be bunched or used as crown cuts. Late-maturing cultivars, Fiesta, Belstar, and Sussex produced 0-27% small, marketable heads. A heavy infestation of flea beetles on the newly planted transplants is thought to be the cause stunting and poor yield.

MATURITY AND HARVEST

Knowing the time it takes to produce a mature head from seed or transplant allows the grower to schedule a planting for harvest at a specific time. In Tables 6 and 7, the average days to maturity between Windsor and Mt. Carmel were calculated from the day of transplanting to the day when half of the heads were harvested, i.e. the harvest date of the 15th head from a population of 30 plants. The difference in maturity between sites for each cultivar was seldom more than 3 days in spring plantings but 25 days in fall plantings. In fall, plantings at Mt. Carmel always took longer to mature than plantings at Windsor.

Maturity. In the 2000 spring crop at Mt. Carmel, the maturity among the six cultivars was 45-54 days (avg. 47 days) (Table 6). The catalogue maturities of the six cultivars were reported to be 56-70 days (avg. 62 days). Catalogue maturity should only be used to compare maturities between individual cultivars, i.e. cultivar A, with a maturity of 60 days, can be harvested a few days before cultivar B, with a maturity of 65 days. Their use in scheduling specific harvest dates is less precise.

In spring 2001 Crop 1 and Crop 2, the range in maturity was 46-64 days (avg. 55 days) and 38-64 days (avg. 52 days), respectively. In Crop 2, average maturity shortened in response to warmer temperatures and increased day length. Regal and Signal, with 38-day maturities in Crop 2, produced smaller heads compared to Crop 1.

In spring crop 2002, the range in maturity among the seven cultivars was 45-60 days (avg. 49 days). Early maturing Major (41 days) and Captain (45 days) produced small heads (0.6 lb)

In fall crop 2000, maturity of six cultivars, planted August 10, ranged between 69-84 days (avg. 75 days). In fall crop 2001, maturity of six cultivars, planted August 3, was 58-86 days (avg. 68 days). In fall crop 2002, maturity among seven cultivars, planted August 10, was 70-91 days (avg. 82 days). The average maturity in fall plantings is obviously much greater than the average maturity in spring crops. The shortening of maturity in successive plantings of spring broccoli and the lengthening of maturity in fall plantings was due to the plants response to changes in temperature and day length and was consistent with earlier observations in multiple plantings of broccoli (Hill 1995). Variations in the maturity of individual cultivars within each crop were due to selected genetic variations. The sequential harvesting of cultivars with varying maturities within a crop was always the same irrespective of changes in temperature and day length.

Harvest span. Another important facet of maturity is harvest span, which I define as the number of days to harvest 95% of the crop. Single heads that matured very early or very late in comparison to the whole population within a single cultivar were excluded. Short harvest spans favor a single harvest by hand or machine. Longer harvest spans require multiple pickings by hand. In general, hybrid cultivars have greater genetic uniformity and maturity is more closely controlled. Open-pollinated cultivars have greater genetic diversity and tend to have longer harvest spans. The harvest spans of individual cultivars were observed to be shorter in spring crops than in fall crops for many cultivars because their maturity lengthens. For example, the average harvest span for all cultivars grown in four spring crops was 5.9 days compared to 11.1 days for three fall crops (Table 7). Although there was little consistency in harvest spans within single cultivars for all spring crops, the short harvest spans of Green Jewel, Regal, and Signal could be accommodated in a single picking. On the other hand, the spans of Terra Blanca (9 days) and Goliath (13 days) would require 3 pickings. In the three fall crops, no cultivars could be harvested in a single picking. At best, Regal in 2000, Landmark in 2001, and Signal in 2001 could be harvested in two pickings. Cultivars with 15 or 16-day spans would require 3 to 4 pickings, which may be ideal for fresh market sales at roadside stands and farmers markets.

MANAGEMENT

Selection of cultivars. The 2000-2002 trials demonstrated that several new cultivars of broccoli, released since 1994, have desirable yield and quality characteristics that are consistent with profitable commercial production and enjoyment by home gardeners in Connecticut. These new cultivars (Table 8) can be added to those reported earlier for Connecticut (Hill 1989, 1995): Premium Crop, Packman, Emperor, Everest, Eureka, Arcadia, Pinnacle, and Barbados. Green Valiant, Symphony, Cruiser, Mariner, and Baron were also on the preferred list, but are no longer offered by seedsmen.

As a group, the new broccoli cultivars reported in Table 8 have been bred for dome-shaped heads that shed water and lessen the probability of head rot. Many of the new cultivars also have heads that extend well above the foliage to facilitate harvest and trimming.

Planting strategies can be developed to satisfy objectives for a series of single harvests to supply

Table 8. Selection of broccoli cultivars with uniform yield and quality for transplanting at specific times during the growing season.

Late April-early May	Mid-May	Mid-June	Early August
Fiesta	Fiesta	Fiesta	Captain
Gypsy	Gypsy	Gypsy	Major
Sussex	Regal	Signal	
Windsor	Signal	Goliath	
	Goliath	Captain	
	Sussex	Major	
	Windsor	Sussex	
		Windsor	
		Titleist	

supermarkets or multiple harvests to maintain a daily supply for retail at roadside stands or farmer's markets.

For single harvests, cultivars with short harvest spans are desirable. Among the cultivars tested for spring harvest, Fiesta, Gypsy, Regal, and Signal had excellent yield and quality with harvest spans less than one week. In fall, only Signal had a short harvest span when transplanted by mid-July.

Only spring-planted Goliath provided multiple harvests of single cultivars, with harvest spans lasting up to two weeks. In fall, Major, Sussex, Titleist, and Windsor when planted by mid-July provided multiple harvests, lasting 10-16 days.

Planting a combination of cultivars with different maturities also attained multiple harvests in spring. Regal or Signal with Goliath and Windsor provided a 3 to 4 week harvest span in July. Similarly, Captain, Gypsy, and Fiesta provided a 3 to 4 week harvest span from late June to mid-July.

For fall harvests, Regal or Signal with Windsor and Titleist provided a 3-week harvest span from mid-October to early November. Also, Captain or Major with Gypsy and Fiesta provided a 5-week harvest span throughout October to early November.

For ease of harvest, Captain, Goliath, Gypsy, Signal, and Sussex were satisfactory choices. Their heads were well extended above the foliage and axillary buds were not well developed. Although these cultivars were easy to trim, they did not provide abundant sprouts for subsequent harvests. The heads of Belstar, Fiesta, Titleist, and Windsor were borne on heavy stalks that were somewhat recessed within the foliage canopy. Although their high-domed heads were of excellent quality, they were more difficult to harvest and trim. These cultivars were not only ideal for crown cuts, but prominent axillary buds developed into sprouts that could be harvested and bunched or marketed as florets.

In choosing the best cultivars for a specific planting, there are a few general rules to consider, based on observations. For April to early-May plantings, cultivars with early maturity seldom produce as well as those with mid-to-late maturity and may be prone to buttoning (formation of a small premature head). For late spring plantings, cultivars with late maturity were more prone to head deformity due to the encroachment of summer heat, compared to cultivars with early-to-mid maturity. In fall, most cultivars, transplanted in late July, produced satisfactory yields irrespective of maturity. For transplanting in mid-August, only cultivars with early-to-mid maturity produced satisfactory yields. Cultivars with late maturity seldom formed marketable heads before frost damaged the crop.

Planting dates. The transplanting window in spring is more restrictive than in fall. In the Connecticut Valley and in areas with moderating temperatures near Long Island Sound, transplanting between April 20 and May 15 was successful (Hill 1995). In the Eastern and Western Highlands, where soil and air temperatures rise more slowly in spring, transplanting should be delayed until May 1. At this time, there is still a 1 in 10 chance of a late spring frost (Brumbach 1965). In cooler areas of the state, transplanting should be completed by May 20.

For fall crops, transplanting in the Connecticut Valley and along the shoreline should begin about July 15 and continue through August 15. In cooler areas of the Eastern and Western Highlands, transplanting for fall harvest should be completed by August 1.

Insect Control. It is essential that broccoli plants should be monitored for insect infestations. Root maggots should be controlled with a soil drench for newly planted transplants, especially in spring plantings (Table 2). Control of flea beetles is essential on broccoli leaves. Heavy infestations can cause stunting of plants and reduce yields.

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